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THE SPRUCE BUDWORM

Cacoecia fumiferana (Clem.)

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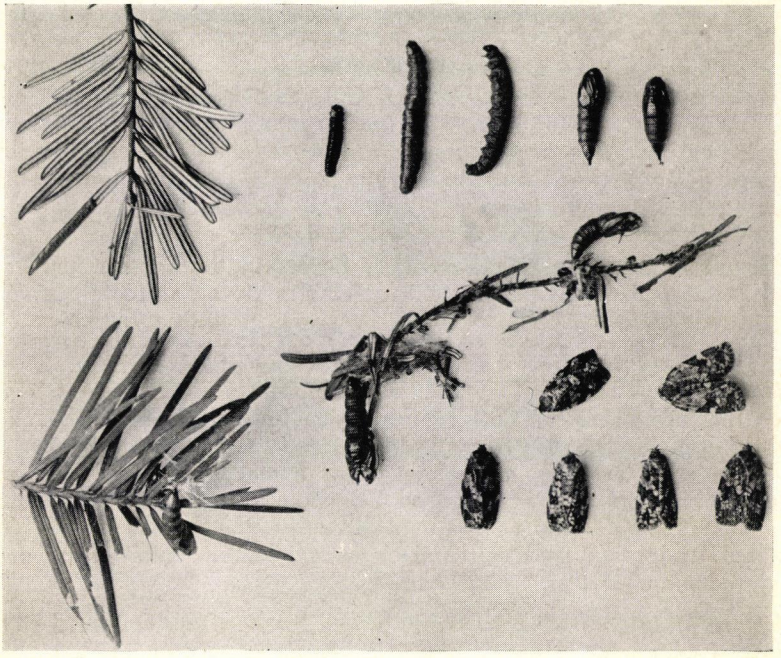

The spruce budworm, showing the life stages and type of injury. (Photograph by H. J. Rust through the courtesy of J. C. Eaenden.)

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THE SPRUCE BUDWORM

Cacoecia fumiferana (Clem.)

History and Distribution:—The spruce budworm probably has been the most serious insect pest in the fir and spruce forests of eastern North America. It is a native species and is distributed thoughout practically the entire range of its food plants on this continent. Outbreaks have occurred at irregular intervals and usually have extended over a long period of years in a region, although generally not more than 3 years in any given locality. In Maine serious outbreaks occurred about 1807 and again about 1878, causing an enormous mortality of balsam fir and spruce. One of the most serious outbreaks on record began in northern Quebec about 1909. This spread southward through New Brunswick to Nova Scotia and into northern Maine, continuing its depredations until about 1923. A simlar outbreak occurred in northeastern Minnesota between 1912 and 1925.

Serious outbreaks have occurred in forests in the western part of the United States and Canada where either Douglas fir or alpine fir predominated. About 1923 the spruce budworm began to attract attention in the Lake States region as an important pest of Scotch pine and jack pine.

Host Trees:—In the Northeastern States, the Lake States, and eastern Canada the insect shows a decided preference for balsam fir; in the Northwestern States, for Douglas fir and alpine fir; in the Lake States and Ontario a biological race shows a preference for Scotch pine and jack pine; in Montana a race has been recorded on lodgepole pine; and recently in Colorado another biological race was found damaging ponderosa pine. White fir, black, red, and white spruces, hemlock, larch, and probably other conifers are injured more or less.

Nature of Injury:—The larvae bore into the opening buds in the spring, and later feed upon the developing foliage. They feed upon the staminate flowers of some of the pines as well as on the foliage. When the larvae become about half grown they begin tying the tips of two or more twigs together with silk, forming small nests. The feeding at this time is chiefly at the base of the needles, the needles being severed from the stem. Many of these severed needles remain entangled in the loose, silken webbing. Because of this habit of feeding on the leaf bases the amount of foliage destroyed exceeds by far the actual food requirements. The new growth of all trees is preferred and is entirely destroyed before the old foliage is eaten. The defoliation usually is heaviest on the upper part of the tree; often the top is killed while the lower part of the tree survives. The trees in a heavy

infestation become scorched in appearance at first, later turning grayish as the brown, webbed foliage disappears.

Intensive studies carried on by forest entomologists over a long period of years both in Canada and the United States, show that in general the intensity of feeding by the budworm on its several food plants can be directly correlated with the time of opening of the buds and development of the new growth. The relative opening of the buds and development of the new growth vary somewhat on the different food plants and with the season, and may not always harmonize with the larval development. The white spruce, with its quickly developing shoots, and the black spruce with its late and slowly growing shoots, both suffer less from budworm attacks than red spruce and balsam fir. The greatest tree mortality occurs in balsam fir-red spruce forests, particularly where the fir predominates and in overmature stands. Little damage has been reported in mixed hardwood-balsam-spruce stands, especially if most of the hardwoods overtop the conifers.

Studies indicate that where outbreaks occur some trees die the first year after defoliation, but the mortality increases the second or third year, and some trees die one or more years after the budworm infestation has subsided. In this last case secondary insects and fungi may play an important part in killing the trees. Such insects as the eastern spruce beetle (*Dendroctonus piceaperda* Hopk.), the balsam bark beetle (*Pityokteines sparsus* (Lec.), the balsam weevil (*Pissodes dubius* Rand.), and other bark beetles, and fungi, such as the shoestring fungus (*Armillaria* sp.), probaly contribute largely to the death of many weakened trees.

Studies in the Lake States have shown that Scotch pine is more susceptible to attack than jack pine, and that red pine and white pine are much less susceptible to attack than jack pine. In stands of jack pine the heaviest infestations occur where there are open-crown trees, or in overmature stands. This is because staminate flowers are most abundant on such trees, and the young larvae are dependent to a large extent on the abundance of the flowers for food before the new foliage appears. Usually when staminate flowers are few, outbreaks do not occur.

Description:—The moth has a wing expanse of about seven-eighths inch and is very variable in its markings. In general it is dull grayish; the forewings are overlaid with bands, streaks, and spots of brown, and near the middle of the costal margin there is a whitish spot. The eggs are pale green, oval, and laid on the foliage overlapping one another like scales on a fish. The newly hatched larva hibernates and upon emerging in spring is pale yellow with a blackish-brown head and a pale brown thoracic shield. The mature larva is nearly 1 inch in length, tapering slightly from the middle. The head is shining black, the thoracic shield brownish, and the body dark brown or dark reddish-brown with conspicuous whitish-yellow, piliferous tubercles. The pupa is about five-eighths inch in length, pale brownish-yellow at first, later changing to a dark reddish-brown.

Seasonal History:—The moths are active in the Northeastern States late in June and in July, and in the Lake States during July and early in August. The eggs hatch in from 8 to 12 days, and the young larvae crawl about until they find suitable places to spin their tiny silken cases, or hibernacula, in which they pass the winter. The small larvae become active in spring, coincident with the bursting of the buds of balsam fir and spruce, which usually

takes place the latter part of April or early in May in the Northeastern States. They bore into the center of the opening buds, remaining concealed as long as the developing foliage permits. When about one-half grown the larvae begin tying the tips of several twigs together, and later these nests become quite conspicuous. The larvae become fully grown in June and pupate among the loose silken webs on the twigs without spinning cocoons.

Natural Control:—Adverse weather conditions, diseases, predators, and many species of insect parasites normally play an important part in the control of this pest. When conditions are favorable for its increase, however, the combined effects of all natural enemies do not prevent outbreaks.

Forest Management:—The following are suggestions for preventing serious injury in spruce-balsam fir forests that are subject to budworm attack:

(1) Remove overmature, slow-growing stands of fir.
(2) Utilize fir on a short-term rotation to avoid slow-growing stands.
(3) Develop mixed hardwood-softwood stands.
(4) In logging leave spruce seed trees, particularly white spruce.
(5) On thin soils subject to excessive drying and on poorer sites plant trees such as white pine.

The following suggestions are offered for preventing budworm injury in Scotch and jack pine plantations and in stands of natural reproduction:

(1) Maintain fully stocked and even-aged stands to prevent development of trees with large crowns.
(2) Space seedlings not more than 6 by 6 feet apart, so that the crowns will close at the age of 10 to 15 years.
(3) Remove susceptible trees in liberation cuttings.
(4) Regulate staminate flower production by the removal of old trees with large crowns.
(5) Log jack pine as soon as it is mature.

Artificial Control:—Fair results have been obtained in Canada by dusting from an airplane, and in the Shoshone National Forest, Wyo., by applying lead arsenate with power sprayers along the roadways.

Concentrated mixtures of lead arsenate have been successfully applied from an autogiro in combating other leaf-eating insects in the forest. Although this method has not been tried for the control of the budworm, it appears to offer considerable promise, especially in combating small outbreaks which may spring up in or bordering large areas of susceptible growth.

Trees in ornamental plantings can be protected from budworm injury by spraying them with lead arsenate just as the shoots are opening in the spring. Use powdered lead arsenate in the proportion of 4 pounds to 100 gallons of water, and add fish oil or linseed oil to the mixture as an adhesive, at the rate of 4 fluid ounces for each pound of lead arsenate.

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